DISCUSSION OF THE DESIGN FOR A FUSION SPACE PROBE - VIPER PULSED FUSION ROCKET

George H. Miley[3] , Akshata Krishnamurthy[1], George Chen[2], Paul Keutelian[2]and Ben Ulmen[2]

[1]Department of Aerospace Engineering, U of IL at Urbana-Champaign, Urbana, Illinois 61801
[2]Department of Nuclear, Plasma, and Radiological Engineering, U of IL at Urbana-Champaign, Urbana, Illinois 618011
[3]NPL Associates, Inc., 912 W. Armory Ave , Champaign, 61821
Phone 217-3565402, e-mail: georgehm@aol.com

The Viper Pulsed Fusion Rocket (PFR) is an ultra-high ISP, variable thrust propulsion system design concept recently de-veloped for outer solar system exploration [1]. Viper PFR is a design study based on a single aneutronic Inertial Electrostatic Confinement (IEC) fusion device producing ISP in the range of 10^4 – 10^6 seconds with advanced p-^{11}B fuel and a neutral propellant [2]. The IEC is fed highly ionized p-^{11}B by an advanced RF permanent magnet helicon array. Anisotropic alpha particle products are magnetically collimated and and < 10% of their energy is directly converted to electrical power needed for secondary systems such as sustaining the reactor. Remaining fusion products energy is quasi-equilibrated with a neutral gas such as hydrogen and magnetically exhausted. Through the coupling of a pulsed mode helicon array, Viper PFR accomplishes a power gain of > 7 by plasma densities in the IEC confinement methodologies operating in a non-Maxwellian beam-beam plasma mode. Viper fills the medium-to-heavy scale of an interstellar-capable probe with launch mass of approximately 30 MT and a total power production of 358 MW. A study of approximate scaling between Viper PFR and previous nuclear engine designs will be presented. Also a development path will be discussed.

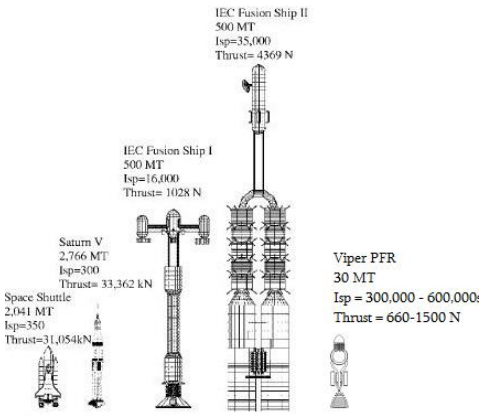

Figure 1. Approximate Scaling Between Viper & Prior Fusion Engine Designs [1],[2].

[1] John Orcutt , Akshata Krishnamurthy, George H. Miley, Paul Keutelian, Ben Ulmen. Viper PFR: Ultra-high ISP Pulsed Fusion Rocket, *DARPA 100-Year Starship Symposium,* Sept. 2011.

[2] Burton, R. L., Momota, H., Richarson, N., Shaban, Y., & Miley, G. H. (2003). Fusion Ship II- A Fast Manned Interplanetary Space Vehicle Usin Inertial Electrostatic Fusion. *American Institute of Physics*, 553-562.